AGRICULTURAL Research

U.S. DEPARTMENT OF AGRICULTURE

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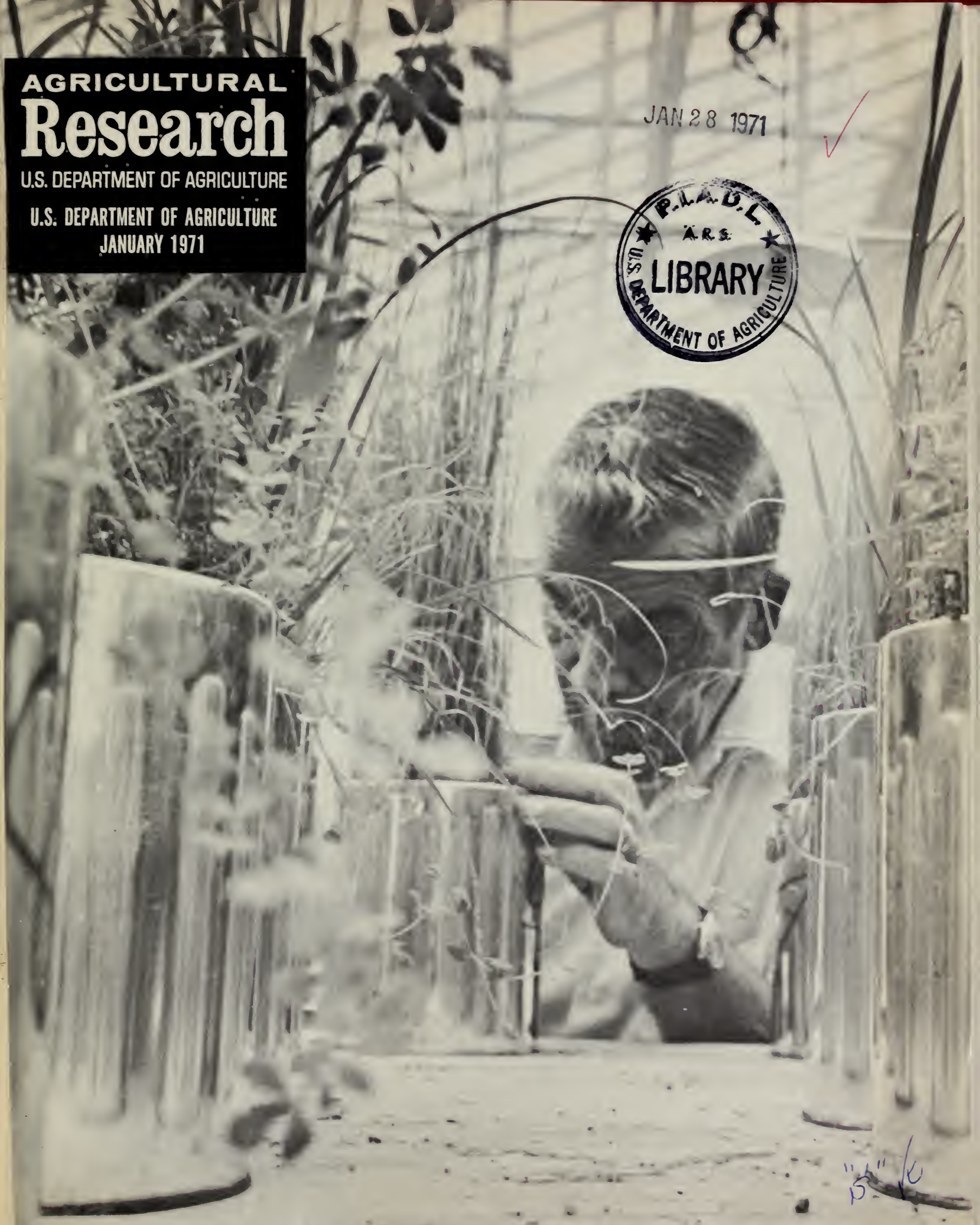

AGRICULTURAL
Research

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Alliance With Nature

The economy of nature, its checks and balances, its measurements of competing life—all this is its great marvel and has an ethic all its own.

—Henry Beston

In the grand design of nature, all wastes are returned to land and water to begin a new cycle of birth, growth, maturity, and death. However limited, the decaying "wastes" are efficiently recycled and reused as new plant and animal life springs eternally from old.

The pattern of return and reuse that nature exemplifies daily in meadow, marsh, and forest ecosystems has a special and timely relevence to the economy of man. For we can no longer indiscriminately discharge the wastes of our industrial, municipal, and agricultural activities into the cheap disposal tanks once provided by abundant air, soil, and water. Earth's natural resources are finite; their resiliency for degrading wastes are hard pressed.

ARS scientists are trying to remedy agriculture's waste disposal problems. For example, they recently developed a dry caustic process for the commercial peeling of potatoes. U.S. processors currently discharge about 1 billion pounds of peels annually into streams and rivers. These peels are carried in the huge amounts of water used to dislodge and wash away lye-softened peels. To curb this type of pollution, the ARS experimental process employs no water in the actual removal of peels. Instead, rubber "fingers" rub off the lye- and heat-treated peels. The peels can be fed to cattle, or buried if no markets exist nearby.

At another ARS laboratory scientists have developed a super-cold peeling process for tomatoes. Here tomatoes are immersed in or sprayed with a coolant such as liquid nitrogen for a few seconds—just enough to freeze the skin but not the flesh. The tomatoes are then quickly thawed, and the skins slit and slipped off. Waste discharge is cut to about half that of present methods because less flesh is lost with the peel.

In other research on recycling and reuse, ARS scientists have found ways to turn whey into confections, straw, feathers, and barn wastes into livestock feeds, and sewage effluent into water for home, industry, and irrigation, to cite only a few more achievements. Progress is being made in other segments of the Nation's economy. Important as these early steps are, we need to do more. These achievements are hopeful signs, however, that man can learn to live in alliance with nature, not in a self-defeating war of conquest.

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COVER: Agronomist Walter H. Armiger at Beltsville, Md., inspects the bases of grasses grown in sample soils brought from strip-mined areas of West Virginia (1070A1012–30).

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Clifford M. Hardin, Secretary
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The experimental ration (BN–37175).

Barn wastes for feeds

TIME WAS, it didn't occur to anyone that livestock waste disposal would become a pollution problem. A farm cycle as natural as sunrise put wastes back into the earth to fertilize the crops that fed the livestock that produced the wastes. But attitudes, population distribution, and land use have changed enough so animal waste disposal will likely have to take some new directions.

One possible alternative is being tested by ARS animal scientists Lewis W. Smith, H. Keith Goering, and Chester H. Gordon.

In feeding trials at Beltsville, Md., the scientists blended barn wastes into dehydrated and pelleted rations. And perhaps more important in the long run, they tested chemical treatments that make barn wastes, as well as other fibrous material, more digestible for ruminant animals.

Only 40 to 60 percent of the energy in forage cell walls is utilized by a cow; the rest ends up as waste material. Therefore, barn waste does have nutritional

potential and could serve as an energy source.

As far as the chemical treatments are concerned, methods of rendering currently indigestible material more nutritionally valuable will gain in importance if humans start competing with livestock for cereal grains as food. Some prognosticators see world population growth as a current prod in that direction.

In early tests, the scientists determined that sheep accepted barn waste rations quite well. With up to 70 percent barn waste, daily intake of a pelleted nontreated ration was as high as that of alfalfa hay pellets.

In other tests, wet barn wastes were untreated, or mixed with sodium hydroxide, sodium peroxide, or sodium chlorite. These mixtures were dried with hot air, ground, mixed with cornmeal and soybean meal, pelleted, then fed to sheep. Barn waste content was 85 percent.

On a dry-matter basis, daily intake tended to be highest on untreated wastes. But digestibility of dry matter was greatest for the sodium chlorite treatment, followed by sodium peroxide, sodium hydroxide, and untreated in that order.

From these trials, the investigators project that a lower level of barn wastes than the 85 percent tested might be effective as a forage substitute.

Before these chemical treatments can be recommended for public use, further research must be conducted to verify their safety. Ill health has not been observed in untreated or chemically treated waste-fed animals, but this aspect has not been specifically investigated.

With the right chemical treatments, barn wastes, as well as many other indigestible fibrous materials, could be commercially processed into feed in a manner similar to woodpulp processing. And eventually, economics could make waste processing profitable for commercial animal feed producers. ■

Mr. Smith shovels barn wastes into commercial dehydrating machine. After dehydration, wastes were mixed with the rest of the ration and pelleted (BN–37178).

Sheep accept the experimental pellets (BN–37180).

Dr. Pursel loads film cassette into microscope to photograph semen specimens (1070A935–28).

fertility test for frozen boar semen

A MAJOR OBSTACLE to using frozen semen in swine artificial insemination (AI) has been lack of an effective laboratory test of sperm fertilizing capacity. ARS animal scientists have now found a promising new technique for evaluating boar semen.

The final test of semen fertilizing capacity is actual insemination of sows and subsequent farrowing of litters. This method, however, is time consuming and impractical for investigating the many facets of semen storage. Sperm motility (percent sperm moving) has been used as an indicator of viability for bull sperm but has proved ineffective with boar semen. Semen quality tests based on sperm response to stains have been of limited value because such procedures alter the sperm.

Acrosome evaluation by a microscopy technique called phase-contrast is the new method physiologists Vernon G. Pursel, Lawrence A. Johnson, and George B. Rampacek at Beltsville, Md., are using to assess boar semen. The acrosome is the caplike structure covering the sperm head. It contains the enzymes required for the sperm's entry into the egg and for fertilization. The scientists reason that fertilization is such a delicate process that acrosome alteration most probably prevents fertilization.

Phase-contrast microscopy requires no staining, but the scientists encountered other problems which they overcame. For instance, since live sperm cells are used, a means had to be found to immobilize the cells without altering them. Then, if the sperm sample on the slide was spread too thin, cells were damaged during examination, confounding effects of treatments being studied.

By examining live, unstained boar semen at a magnification of about 1,560 times, the scientists have discovered that when the sperm are cooled below 55° F., many of the sperm acrosomes are damaged. Five categories of acrosomes have been identified, ranging from the normal to completely loosened acrosome. Percentage of normal acrosomes is used as a quantitative measure of each semen sample.

Since boar sperm are extremely sensitive to mere cooling, the researchers have concentrated their efforts on learning what factors increase the cold resistance of sperm. The semen extender composition, pH, period of incubation before cooling, rate of cooling, and sperm concentration have all been found to influence cold resistance. This basic information will be useful in the actual semen freezing experiments that are in progress.

Semen storage is still the critical variable in successful use of AI with swine. But the ARS scientists are hopeful that the acrosome evaluation method can provide the breakthrough to conclusive storage research. ■

NEW:

air-dried mushrooms

THE MUSHROOM, a favorite of culinary artists everywhere, can now be dried and stored while still retaining the distinctive flavor and color for which it is famous.

An air-drying process developed by ARS researchers working in Philadelphia, Pa., near the mushroom capital of the world, Kennett Square, is now being used commercially to produce dehydrated mushroom pieces for dry soup mixes. The process is economical and the dehydrated mushrooms compete favorably in price and quality with imported, processed mushrooms that corner a large part of the U.S. market.

Better methods of preserving mushrooms are very important to the industry because the fresh mushroom is a highly perishable product. It must be eaten or processed within 5 days after harvesting or it becomes brown and undesirable for cooking.

Freeze-dried mushrooms are an excellent product but expensive. Air-dried mushrooms, on the other hand, are undesirable both in color and shape when they are blanched before processing to inactivate enzymes. Blanching also reduces the solids by 20 percent, causing loss of nutrients and flavor and imposing a pollution problem.

The air-drying process developed by engineer Michael Komanowsky and food technologist Florence B. Talley at the ARS Eastern utilization research laboratory eliminates blanching. Instead, the mushrooms are dipped in chlorine solution to kill microorganisms, then cut up and treated with sulfite to inhibit browning. The mushroom pieces are then dried with hot air, first at a low, then at an elevated temperature.

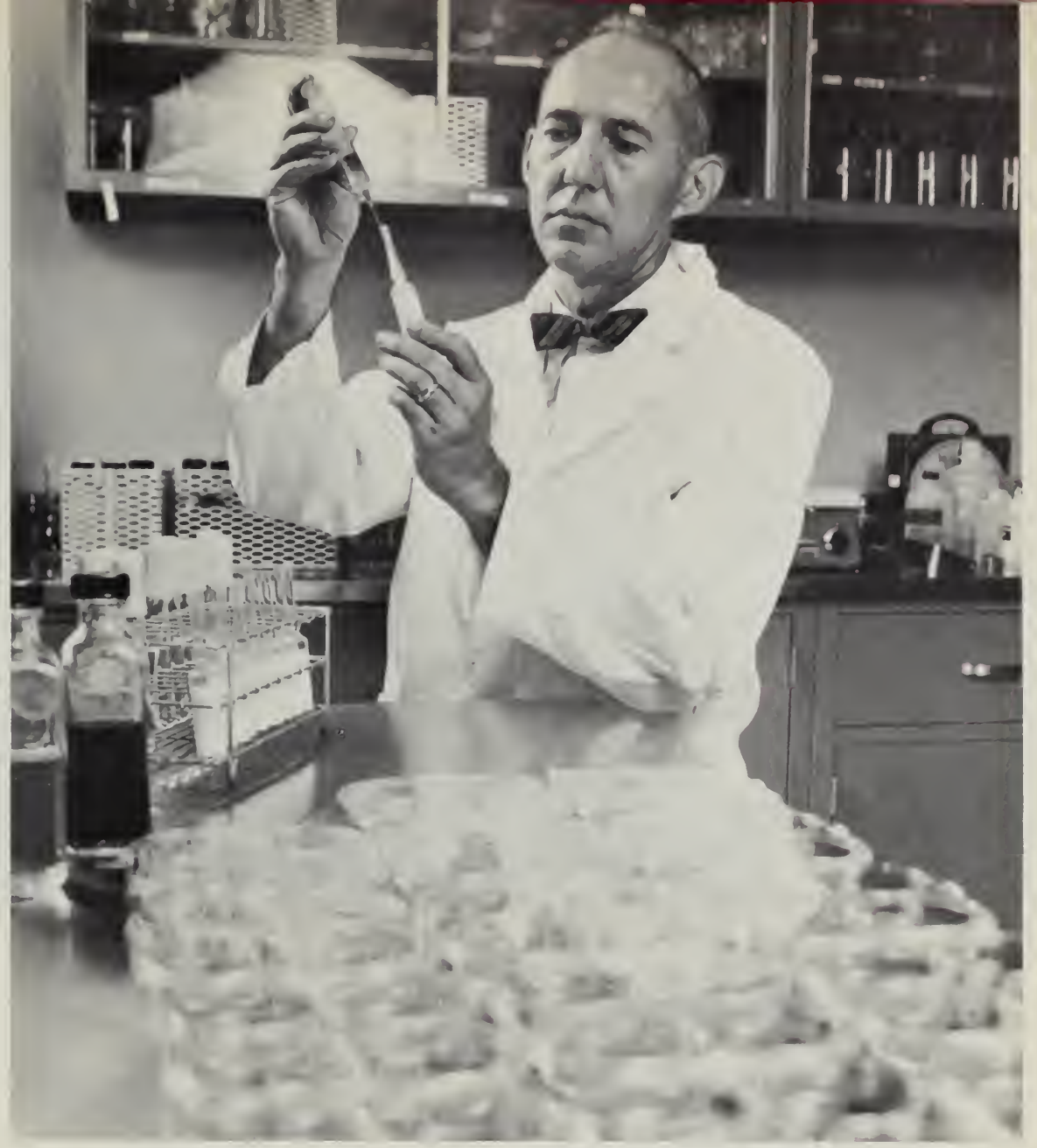
Best results are obtained when mushrooms from the first "breaks" are used. These mushrooms are usually the firmest. A "break," the sudden appearance of a large number of mushroom clumps, occurs four or five times during a 2- to 3-month period after the mushroom spawn is broadcast on the beds. Late breaks tend to produce processed mushrooms darker in color.

When the unblanched, air-dried mushrooms were taste-tested by two commercial companies that are large-scale users of dried mushrooms, they were found to be superior to imported, air-dried mushrooms in flavor, color, and texture. And they were equal in flavor to freeze-dried mushrooms which cost twice as much to produce. When hermetically sealed in packages, the air-dried mushrooms could be stored for at least 7 months while retaining the desired flavor and color.

The new air-dried mushrooms may well find their way into other commercially manufactured products such as instant gravies and casserole dishes, giving the industry new markets. ■

Left: *Mushrooms were added to pot of boiling water which was removed from stove. After 5 minutes, they were drained, then sautéed in butter (1170A1061–5).* ***Right:*** *In the test kitchen, Mrs. Talley hands mushroom sample to taste panelist (1170A1058–11).*

Dr. Moats prepares sample for heating (0870C762–10).



destroying SALMONELLA by heat

The material carrying this bacteria can affect its susceptibility to heat

A VARIETY of chemical constituents in food protect *Salmonella anatum*, a food poisoning bacteria, from destruction by heat—a finding that may help researchers find ways to reduce the incidence of sickness caused by this organism.

In studies at Beltsville, Md., ARS chemist William A. Moats, microbiologist Roger Dabbah, and technician Virginia Mae Edwards added *Salmonellae* bacteria to various test materials, which were heated to 131° F., for 35 minutes. Bacterial readings were then made.

Some materials rendered bacteria more susceptible to destruction by heat. Glucose and sodium citrate, for example, reduced *Salmonellae* survival to only nine bacteria or less per milliliter of test material.

Other materials protected *Salmonellae*. These included a commercial ice cream stabilizer, various carbohydrates, proteins, and some amino acids. The carbohydrates sucrose, rhamnose, and mannitol, for instance, had *Salmonellae* survival rates ranging from 31,000 to 58,000 per ml. But milk was the most dramatic example. "Milk protected bacteria from heat better than anything we tested," Dr. Moats reported.

Milk commercially sterilized by heating for a few seconds at very high temperatures was selected for testing because it more closely resembles fresh milk from the cow than does milk sterilized by autoclaving for 15 minutes. Autoclaving, a method of heating by steam under pressure, was used in many of the previous tests.

The heat treatment employed in the ARS experiments was considerably less stringent than treatments used for commercial pasteurization of milk; therefore, the tests do not imply that *Salmonellae* can survive pasteurization.

In subsequent tests, the sterilized milk was subjected to autoclaving, which "largely destroyed the protective effect previously existing in the sterilized milk," Dr. Moats said. "Bacterial survival was 1,000-fold less than in unautoclaved milk. Unfortunately, much of the past data on heat resistance of bacteria in milk has been obtained using autoclaved milk and therefore needs to be reevaluated."

Of the 17 amino acids that were also tested, alanine gave the most protection against heat. About 35,000 bacteria per ml. of alanine test material survived exposure to the experimental heat treatment. Ten other amino acids also gave considerable protection in the tests.

"Although there may be other explanations for these results," Dr. Moats said, "the most attractive theory is that these food constituents react with heat-sensitive proteins in the bacterial cell, stabilizing the proteins to heat." ■

Right: *Severely eroded strip mine terraces on Bolt Mountain, W. Va. (1070X991–6).* ***Top, far right:*** *Mr. Jones broadcasts fertilizer on bermudagrass at White Oak Mountain (1070X992–5).* ***Bottom, far right:*** *He inspects weeping lovegrass on heavily limed plot with original pH of 2.8. Bare plots were seeded but not limed (1070X993–21).*

Above: *Mr. Armiger measures lovegrass growing in a Beltsville greenhouse (1070A1012–16).* ***Below:*** *As Mr. Hungate holds scale, Mr. Armiger records plot number and weight of grass from a 4-foot-square section of plot (1070X990–11).*

PROJECT R

RECLAMATION of 250,000 acres of strip-mining spoil banks in Virginia and West Virginia—and similar devastated areas throughout the Nation—may be possible with revegetation techniques under evaluation at White Oak Mountain, W. Va.

More than 3 million acres have been disturbed by surface mining in the United States. The leaching and eroding of coal mine spoil bank materials alone send more than 2 million tons of sulphuric acid plus millions of tons of sediment annually into the Nation's streams. Revegetation would stabilize the spoil bank materials against erosion, significantly reduce runoff, beautify the spoils, and produce a forage and hay crop.

Updated mining regulations in most States put the burden of reclamation on mine operators. In West Virginia, 80 percent coverage of legumes or perennial grasses must be established in two

ECOVERY

growing seasons after the mining permit has expired. If woody plants are used, at least 600 stems per acre must survive the two growing seasons.

Acidity is one major problem of reclamation. In the Appalachian spoils, it comes from sulfur-bearing pyritic rocks that oxidize to produce sulfuric acid. When the acid is present, various mineral ions—iron, aluminum, manganese, nickel, copper, zinc—are made available in quantities toxic to plants.

Agronomist Walter H. Armiger, soil scientists Charles D. Foy and Orus L. Bennett, and agricultural engineer J. Nick Jones, Jr., all of ARS, approached this problem two ways: By using plants that can tolerate some toxicity and by raising the pH of soil at the site through fertility management.

Raising the pH decreases the solubility of certain mineral ions and hence their toxicity to plants. Researchers have a wider choice of tolerant plants at higher pH levels. Some tolerant plants themselves raise the pH in the vicinity of their own roots and thus create a more favorable environment for growth.

Several fertility treatments were used in the study. Best results were obtained under these conditions:

- When the pH was below 3.5 (it went as low as 2.5), lime was the primary material necessary for plant growth.
- When the pH was about 4.0, rock phosphate was used to supply phosphorus, calcium, and other elements as well as to raise the pH. It also controlled the availability of other nutrients at levels adequate for certain grass species. By using rock phosphate, the ARS researchers employed the acid in the soil to create soluble phosphorus on a slowly available basis—a process simulated commercially in making superphosphate. Rock phosphate is less expensive than other forms of phosphorus fertilizers.

All areas also received nitrogen and potassium treatments.

In the first year of the West Virginia trials, best results with plants came from weeping lovegrass and tufcote bermudagrass, both providing 100 percent coverage. A recent harvest showed weeping lovegrass had produced 2.2 tons per acre (dry matter) on plots receiving rock phosphate.

Phosphorus seems to be the most important of the minerals used on the spoils, the researchers say, but equally important to revegetation, is the use of a mulch. At White Oak Mountain, Mr. Armiger and Mr. Jones used hand-applied straw. On control plots where no mulch was applied, no growth was established. The spoil material loses moisture fast near the surface and forms a hard crust nearly impossible for young plants to break through.

Mr. Jones planted wheat, barley, and rye last fall hoping to establish enough plants to serve as a mulch in the spring and aid in establishing a permanent crop. He's looking for any easy, cheap, sure method of getting a mulch.

Other plots were started at White Oak Mountain last fall including orchard grass, alfalfa plus orchard, ladino clover, hairy vetch, bromegrass-alfalfa, Kentucky 31, red fescue, ladino clover-orchard, alfalfa, crimson clover, and brome. All have become established, with hairy vetch making the best early development. The point of the fall seeding is to see if the grasses will establish themselves enough to survive the harsh West Virginia winter.

Mr. Armiger is continuing the study of plant varieties and fertility management in the greenhouse throughout the winter on soils from the mining sites.

White Oak Mountain is one of several sites under test by ARS researchers in studies on strip-mine reclamation. The research program is conducted cooperatively with the Agricultural Experiment Stations in Virginia and West Virginia and USDA's Forest Service and Soil Conservation Service. ■

. . . for better feed converters

A cow is a machine for converting feed into milk.

That kind of definition might irritate some people, but it's becoming increasingly crucial to think about a dairy business in just that way.

Efficiency, the bugaboo and byword of most industries, is a major concern when the biggest cost of producing milk is feed. While tradition in the dairy industry leads breeders and farmers to select cows mainly for high milk production, a group of ARS dairy scientists took a look at how this kind of selection affects feed efficiency.

Fifteen years of data on the Beltsville, Md., Holstein herd were analyzed by ARS animal scientists Robert H. Miller, Norman W. Hooven, Jr., and James W. Smith.

To the credit of the milk production school of cow selection, they found feed efficiency strongly related to milk yield—high producers also made more milk per unit of feed. This means that feed efficiency is raised by selecting for milk yield.

The investigators got some interesting results on the body size to efficiency relationship—cows above average in weight for the herd tended to be less efficient feed converters than their more petite sisters. They found that the 2-year-old cows studied hit both their peak feed efficiency and income over feed cost at about 1,170 pounds, but herd average weight was 1,280 pounds. Smaller cows have less body tissue to maintain, so can put more of what they eat into milk production.

While the scientists want to collect more data on the relationship, they see many possible areas where body size information may aid in efficient selection and management.

One application of the body-weight relationship is in the time it takes a heifer to start producing income for the dairyman. Currently, farmers breed their Holstein heifers to calve for the first time at 27 to 28 months of age. But the scientists concluded that since smaller cows had higher income over feed cost, delaying the breeding of heifers to attain large body size is not necessary. Earlier calving would add a comparable amount of time to total productive life of the animal, resulting in greater lifetime profit.

Weight gain during lactation is also critical. They found that cows that put energy into making body fat during peak lactation produced less milk and were less efficient.

Looking at income over feed cost, cows peaked at 1,170 pounds of body weight with $320, but cows weighing over 1,450 pounds in first lactation earned only $250 or less over feed cost.

"We don't want to say that body size alone is sufficient basis for selecting cows," Dr. Miller concludes "but it is a factor to consider in evaluating animals for profitability." ■

Vaccine for leptospirosis

LEPTOSPIROSIS, a disease that has long plagued the cattle industry, may be brought under control with a new experimental vaccine.

The vaccine, made from a special strain of *Leptospira pomona*, has been shown to be safe and effective in tests at the National Animal Disease Laboratory, Ames, Iowa.

ARS veterinarian O. H. V. Stalheim found that the strain of *L. pomona* used apparently does not produce the disease and, importantly, it protects against infection in the urinary tract as well. The vaccine protected hamsters, swine, and cattle from both visible signs of the disease and kidney infections. And the vaccine did not cause fever, interrupt pregnancy, or allow organisms to become established in the blood or urine.

Leptospira are commonly found in wild animals (skunks, raccoons, foxes, deer, and rodents) which can spread the disease to domestic animals and man. Water and feed that have been contaminated with infected urine are common sources of infection. In cattle, *Leptospira* cause fever, loss of appetite, reduced milk production, and abortions. Young animals may be stunted and unthrifty and sometimes die.

Leptospirosis is difficult to diagnose and treat. Animals that no longer show signs of the disease may be carriers of the organism, spreading it to susceptible animals.

In one experiment, 17 steers were each given 5 milliliters of vaccine, while six others were unvaccinated. All 23 head were placed in random groups. After 6 months, the steers were exposed to virulent *L. pomona* organisms.

After exposure to the virulent *L. pomona*, only the unvaccinated cattle developed signs of leptospirosis. All tests on urine were negative for *L. pomona* in the vaccinated steers.

In another test, the longest for duration of immunity, 20 steers were vaccinated with the experimental vaccine, while seven steers remained unvaccinated. When these steers were exposed to virulent *L. pomona* organisms 14 months later, no evidence of infection was found in the vaccinated cattle. Also, keeping vaccinated and unvaccinated cattle together demonstrated the safety of the vaccine, since the unvaccinated cattle did not contract the disease from the vaccinated cattle.

Immunity tests on other laboratory animals showed vaccination would protect hamsters for 3 months and pigs for 7 months against infection from leptospirosis. ■

Dr. Stalheim injects vaccine (PN–1926).

Swine breeding by computer

SWINE BREEDERS generally agree that predicting animal performance involves a high degree of uncertainty. With the development of high-speed computers, a new method has evolved to challenge this uncertainty.

The method, called "Monte Carlo," is a computer technique in which chance, or random, genetic processes operating during germ cell formation and fertilization are simulated, and their consequences studied in detail under specified conditions. Ten generations of hogs can be "electronically produced" in minutes.

Animal scientist Ben Bereskin, with co-workers at the ARS Regional Swine Breeding Laboratory, Ames, Iowa, conducted one such study to look at combined effects of inbreeding and selection over 10 generations in three sizes of populations.

Each line was maintained with one sire and 10 dams, two sires and 20 dams, or four sires and 40 dams per generation. A total of 480 litters, with about eight pigs per litter, were simulated per generation. Two traits—growth rate and litter size—were studied.

Results showed no genetic gains in simulated growth rate in the 1-sire lines and only slight improvement in the 2-sire lines because of some harmful inbreeding effects. Because selection was based mainly on growth rate, no gains in the size of the litter were achieved.

In the 1- and 2-sire lines, little accuracy was achieved in predicting genetic gains for any particular line and only little more reliability was found in the 4-sire lines. But when several lines of the same size were considered as a group, their average predicted genetic gain was close to the average value actually achieved with live animals.

Monte Carlo studies are particularly useful where risks, time, or expense would be prohibitive with live animals. Dr. Bereskin points out that Monte Carlo studies are not intended to replace live animal research, but rather to serve as an auxiliary tool in future breeding studies. ■

the elusive IgA

Important for disease immunity in humans, this protective protein has now been found in cattle

A NEW APPROACH to controlling troublesome diseases in cattle such as mastitis, parainfluenza, and intestinal infections in calves, may involve a specific immunoglobulin called IgA.

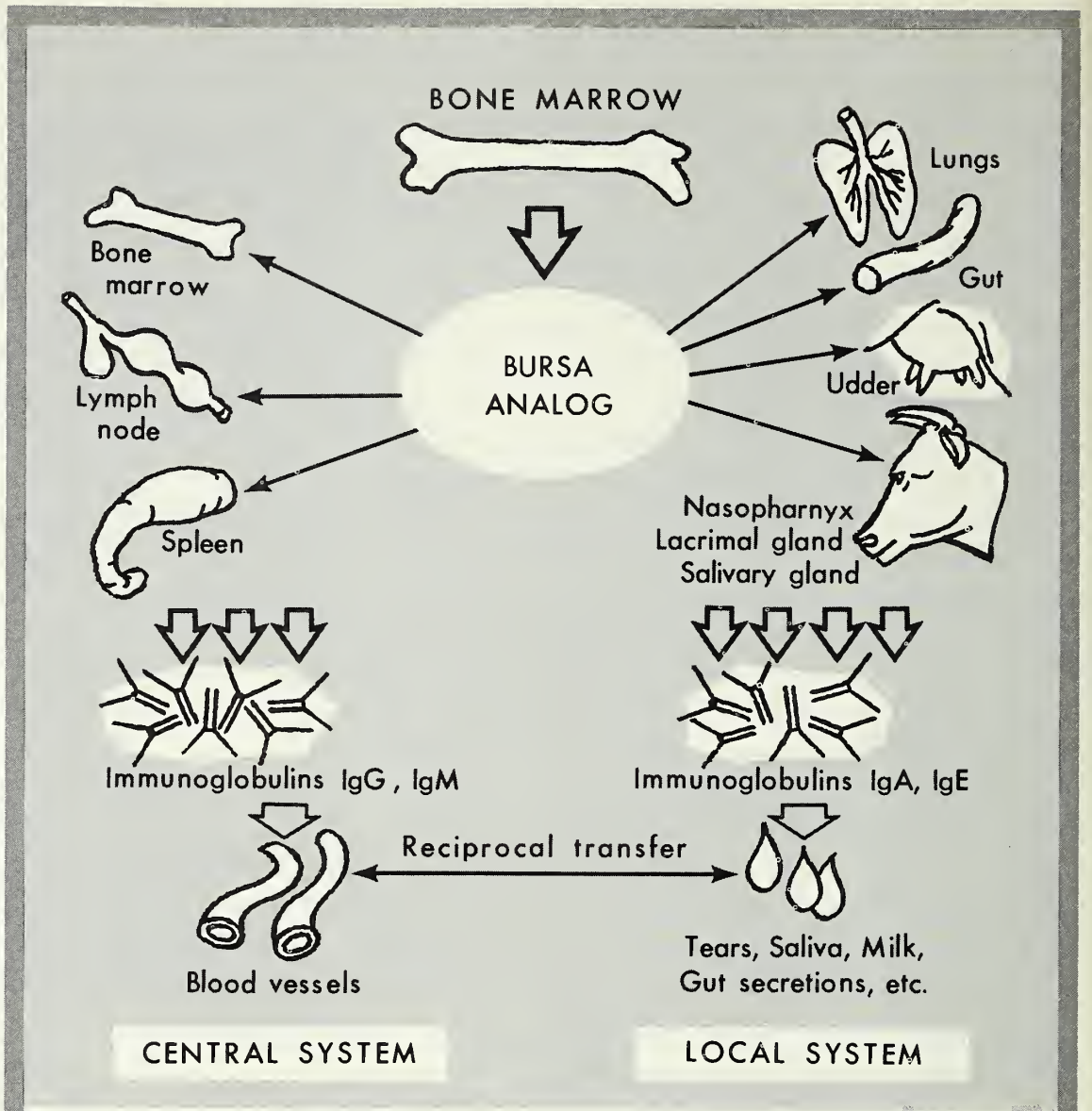
Immunoglobulins are large proteins found in milk and other secretions, as well as in blood serum. They combine specifically with an attacking organism, destroy its disease-producing capacity, and stimulate the synthesis of more of their own type of immunoglobulins. Thus they provide what is known as humoral immunity.

IgA has long been known as the principal immunoglobulin of milk and other secretions in humans. But it was found only recently in cow's milk by biologist John E. Butler, of ARS' Eastern utilization research laboratory in Washington, D.C. Bovine immunoglobulins in milk are primarily of the IgG type.

In studying the allergens of milk, Dr. Butler came to believe that bovine IgA existed and that it may somehow be an important part of the cow's immunity system. A possible clue was provided by chemists Merton L. Groves and William G. Gordon, working independently of Dr. Butler in another Eastern utilization laboratory in Philadelphia, Pa. They discovered a small protein in the whey fraction of milk that they called glycoprotein-a. They were unable to identify it as an immunoglobulin.

Human IgA has a smaller secretory component attached to it that is presumed to aid in its transport or to protect it in the often harsh environment of the secretions. When Mr. Groves and Dr. Gordon described their glycoprotein-a, Dr. Butler suspected it might correspond to this secretory component of IgA in human milk. If so, its finding might suggest that there is a bovine IgA; Dr. Butler's experiments proved this to be true.

The finding of both types of immu-



Lymphoid cell precursors migrate from the bone marrow to the Bursa analog (lymphoid tissue analogous to the Bursa of Fabricius in chickens) where they undergo differentiation and at a later stage in development migrate to various body tissues. The lymphoid cells found in the spleen, bone marrow, and lymph nodes have the potential to produce immunoglobulins IgG and IgM which are released into the bloodstream; the cells in the lungs, gut, udder, nasopharnyx, lacrimal and salivary glands can produce immunoglobulins IgA and IgE which are released into the fluids produced by these organs (milk, tears, saliva, etc.). Since there is some movement across the barriers separating blood serum from secretions, some IgA and IgE will be found in the blood, and some IgG and IgM, in the secretions (PN–1927).

noglobulins in cow's milk helped to better explain the mechanism of immunological response. The cells that synthesize immunoglobulins are known collectively as lymphoid tissue and are found throughout the body. Some are distributed *locally*—in the lymphoid cells of the digestive and respiratory tracts and in the secretory glands producing milk, saliva, and tears—and they synthesize immunoglobulins like IgA. Others are distributed *centrally*—in the spleen, bone marrow, and lymph nodes—and they synthesize immunoglobulins like IgG. Thus humans and cows alike have a local secretory system and a central system, providing two lines of immunological defense against disease-bearing organisms.

Dr. Butler's work, confirmed by collaborative research at the State University of New York in Buffalo, proved that both systems are characteristic of the human and the cow. In his studies of bovine immunoglobulins, Dr. Butler has shown that the spleen and lymph nodes make up the central system where the IgG immunoglobulins, found mostly in blood serum, primarily come from. The secretory system, found in the mammary, lacrimal, and salivary glands, as well as the ileum (gut), lung, nose, and uterus, produce large amounts of IgA. The mammary glands and uterus produce both types of immunoglobulins.

IgA is scarce in cow's milk because it is overwhelmed by IgG which is both synthesized locally and transported from the blood in huge quantities to the udder—primarily just before calving for the benefit of the suckling offspring. IgA does predominate in other cow secretions, such as tears, nasal secretions and saliva.

Understanding the complexity of the bovine immune system may lead to more effective control of infections by stimulating the lymphoid cells which synthesize the appropriate immunoglobulins. ■

... a new green vegetable

A NEAR RELATIVE of collard and mustard greens, *Brassica carinata,* may one day become available as a tasty new leafy green vegetable for American tables.

The flavor of the cooked canned or frozen greens is somewhat milder than collard greens without the pungency of mustard greens.

The plant was imported in 1957 from Ethiopia where it is grown in small fields near villages. It is planted mainly for its tender leaves and sprouts which are boiled and eaten. The seed is found in European commerce under the trade name of Ethiopian rapeseed. It has yielded 35 to 38 percent oil.

ARS food technologist Thomas S. Stephens and chemists Guadalupe Saldana and Francis P. Griffiths evaluated the greens at the ARS food crops utilization research laboratory, Weslaco, Tex. The greens were grown in 1968 and 1969 at the Texas A. & M. Lower Rio Grande Valley Research and Extension Center under the supervision of W. R. Cowley, research superintendent.

The crops were harvested by hand for evaluation twice during each season. Plants were washed and all damaged and discolored leaves removed, as were the stalks of some plants that had become fibrous.

The amount of crude fiber in the first harvest each year was not excessive when compared with 0.03 percent found by the investigators in fancy canned spinach. Crude fiber content of 0.10 percent in canned and frozen greens was not considered objectionable by those who tasted the cooked greens.

In taste tests, persons who like the flavor of mustard and collard greens enjoyed the test greens. They commented, however, that the leaf stems and tender stalks detracted somewhat from the appearance, but not the flavor, of the canned product. In contrast, the frozen product was much more attractive because the leaves, leaf stems, and tender stalks had been chopped and thoroughly mixed in the same fashion that blanched frozen greens are commonly prepared commercially.

The amounts of protein, ash, and calcium are about the same as in collard, mustard, and spinach greens. But the estimated yield of the new greens ranges up to 20 tons per acre, about five times that of spinach, with corresponding increase in amount of protein per acre.

In studies on the protein fraction of the leaves, ARS chemist Harold E. Brown, also of the Weslaco laboratory, found it to be a good source of lysine and other essential amino acids. The protein fraction is easily obtained from juice pressed from the ground leaves. ■

Minnows take on mosquitoes

MINNOWS can provide good nonpolluting control of mosquitoes in California rice fields.

Each year, nearly 400,000 acres of rice in California are potential breeding grounds for mosquitoes unless control measures are taken. In 1969, three of the State's 14 rice-producing districts stocked paddies with mosquito-eating fish, but in general, this practice has been limited by the lack of information on the number of fish required.

In studies at Firebaugh, Calif., ARS entomologist James B. Hoy and David E. Reed, manager, Fresno Westside Mosquito Abatement District, found that stocking paddies with 200 mature *Gambusia affinis* female minnows per acre supplied enough minnows to reduce mosquito production by 95 percent in the tests.

Treatments of 1,000, 200, and 0 fish per acre were assigned to the rice paddies of a 145-acre field owned by a large rice producer. There were six paddies to each treatment.

Levee boxes on either side of each paddy were screened with four- and eight-mesh hardware cloth to prevent fish from moving to adjacent paddies.

The paddies were stocked in late May and evaluated for mosquito production five times at 2-week intervals, beginning June 23. Evaluations were made by Mr. Reed and two experienced men who were intentionally not told about the different stocking rates. Each evaluator used his own method for sampling. All of the results were similar.

For the entire season, 94 percent of the larvae (*Culex tarsalis*) found were in the 0-fish-per-acre paddies, 5 percent were in the 200-fish-per-acre paddies, and 1 percent were in the 1,000-fish-per-acre paddies.

Because the screens kept fish from congregating at one end of the field in 1969, further tests were made during 1970, comparing entire fields instead of paddies.

In cooperation with Eugene Kauffman and Allan O'Berg of the Sutter-Yuba Mosquito Abatement District, Dr. Hoy and Mr. Reed conducted two tests, each involving 21 entire rice fields. The results confirmed their earlier studies; stocking rates of 200 to 300 mature females per acre will provide good mosquito control.

Future tests to perfect this method of control will include mass-rearing of the fish, early season stocking, and the stocking of each paddy by helicopter. ■

Foiling the bean beetle

SOIL MULCHES of aluminum foil on paper can reduce Mexican bean beetle damage to garden beans.

The successful use of aluminum foil to repel aphids and to control insect-transmitted virus diseases in plants (AGR. RES., March 1969, p. 7) prompted ARS entomologists Floyd F. Smith and Ralph C. Webb to test the effects of reflective mulches on the Mexican bean beetle.

Preliminary experiments at Beltsville Md., showed that plants in soil mulched with aluminum foil on paper suffered foliage damage of only 9 percent compared to 58 percent damage recorded without mulch. Mulches of aluminum paint on paper and clear polyethylene plastic showed damage of 38 and 72 percent, respectively.

Tests were made on bean plots of three 8-foot rows that were 3 feet apart.

Four plots were assigned to each condition. The beetles flew to the plots from nearby infested beans, and their egg clusters were counted every 2 to 4 days.

Normally, when Mexican bean beetles alight on bean plants, they move almost immediately to the underside of the leaves where they feed and lay eggs in clusters of 20 to 70 or more. Larvae hatching from a single cluster will severely damage all foliage for 3 to 4 feet along a row of beans.

In the plots treated with aluminum foil, however, light reflected by the shiny foil upward to the underside of the leaves, greatly disturbed the adult beetles. They fed less and laid fewer egg clusters per female than those observed on unmulched soils.

Although larvae appeared to feed normally in both mulched and unmulched plots, the decreased population in the foil-mulched plots caused less damage to the bean crop. ■

Researchers laid foil around plants. No insecticides were applied (PN–1928).

More agents of chewing disease

Russian knapweed may cause chewing disease of horses—and ARS scientists now suspect that other members of the plant genus to which it belongs could also produce the disease.

Previously, only yellow star thistle—like Russian knapweed a member of the genus *Centaurea*—was known to cause the disease. But ARS veterinarian R. Keith Farrell, Pullman, Wash., and associates reported a case when a horse was confined in a Washington pasture infested with Russian knapweed but no yellow star thistle.

Chewing disease (*Nigropallidal encephalomalacia*) is characterized by the horse's inability to swallow food and water. Damage to the brain prevents the animal from moving food to the back of its mouth for swallowing. Affected animals appear drowsy and become dehydrated and thin from lack of nutrition.

Treated wool doesn't ignite

Wool is highly flame-resistant and is hard to ignite, but when ignition does occur, the flames sometimes propagate. So for some uses, it is desirable to treat wool fabrics to give added protection from flames. The need for fabrics with more flame resistance for certain uses was recognized in the Amended Flammable Fabrics Act of 1960.

Such a flame-resistant treatment for wool is now under development at ARS' Western utilization research laboratory, Albany, Calif. Treated wool chars but does not melt or ignite and remains flame-resistant after dry cleaning. The treatment does not affect color or tensile strength nor does it seem to impair desirable properties of wool.

It can be applied to wool in any physical form—scoured raw stock to woven or knitted fabric. However, the scientists do not yet know whether it can be used along with other chemical treatments such as those that impart shrink resistance and oil and water repellency.

Treated wool fabric on left was held in flame for 2 minutes; untreated wool, which had ignited, was held in flame only 2 to 3 seconds (PN–1929).

Developed by ARS chemists Mendel Friedman and Sandra Tillin, the treatment consists fundamentally of reacting the fabric with the chemical *bis* (β-chloroethyl) vinyl phosphonate. Studies so far have been on a laboratory scale. The scientists are still developing the basic information needed to begin the next stage of research—designing and operating pilot-plant equipment for practical trials.

Restoring depleted range

Depleted rangeland doesn't have to be.

In a 4-year study at Mandan, N. Dak., ARS agronomists George A. Rogler and Russell J. Lorenz brought back into high production ranges that had been abusively grazed for some 50 years.

After controlling weeds with 2,4-D, they applied 40 pounds per acre of nitrogen fertilizer a year. By the fourth year, dry-matter production on the treated range was almost 3½ times that on the untreated range where abusive grazing was continued. High-producing midgrasses on the treated range increased total forage production from 55 lb/a the first year to 1,882 pounds the fourth year. And beef production the fourth year was 136 lb/a compared with 52 lb/a on the untreated range.

The researchers say that the combined treatment also increased productivity on ranges in good condition. In studies over an 11-year period, average dry-matter production on treated range was 3,390 lb/a, compared with 2,160 lb/a on untreated range. Average beef production was 97 lb/a compared with 50 lb/a.

When the nitrogen rate on the good range was raised to 80 lb/a, the average yield jumped to 3,894 lb/a, and average beef production rose to 124 lb/a.

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AGRISEARCH NOTES

For more grass seed

Grass seed growers can get top seed production with new findings on the effects of plant age and spacing.

In studies at Pullman, Wash., ARS agronomist Chester L. Canode determined that 1- and 2-year-old Kentucky bluegrass plants in 12- and 24-inch spacings produced the highest seed yields, with a gradual decline of seed production from plants 3, 4, and 5 years old. In 36-inch spacings the seed yield was about the same from the 1-, 2-, and 3-year-old plants, with the peak seed yield from 4-year-old plants. Five-year-old plants produced relatively low yields regardless of spacing.

Intermediate wheatgrasses and smooth bromegrass seed yields reacted to increased plant age the same as the Kentucky bluegrass. However, crested wheatgrass—the only bunchgrass tested—gave a slightly different yield pattern. The 1- and 2-year-old plants produced the highest seed yield, but the 5-year-old plants produced more seed than 4-year-old plants.

Tobacco resists mosaic disease

Tobacco mosaic, a disease causing an estimated annual loss of from $1 to $2 million in Maryland-type tobacco, may soon be a thing of the past.

ARS agronomist Harold A. Skoog, Beltsville, Md., and agronomist Marvin K. Aycock, Maryland Agricultural Experiment Station, College Park, have developed Maryland 10, a recently released variety with mosaic resistance.

Maryland 10's resistance to mosaic virus is of the hypersensitivity type, which means that the plant cells die rapidly once attacked by the virus. Since the dead cells are no longer able to supply the living environment necessary for reproduction of the virus, the spread of the disease is quickly contained.

The new variety is also resistant to fusarium wilt and in agronomic characteristics is very similar to Catterton, a popular southern Maryland variety from which it was developed.

Southern Maryland tobacco, an air-cured type marketed from late April into June, is well known for its good filling capacity in cigarettes and ability to hold a burn. About one-third of this tobacco is exported to Switzerland and West Germany.

Mud in feedlots cuts gains

Mud in feedlots can seriously reduce beef gains.

In a 3-year study at Davis, Calif., ARS agricultural engineers Theodore E. Bond and Robert L. Givens, and California Agricultural Experiment Station animal scientist William N. Garrett and agricultural engineer Stanton R. Morrison found that mud reduced daily gains 25 to 37 percent when compared with concrete pens, and increased the feed required per pound of gain 25 to 33 percent.

Providing a dry place to rest in the muddy pen, however, cut both losses considerably. Gain was reduced only 10 percent while conversion efficiency dropped 4.7 percent.

The Davis tests were conducted to compare the effects of mud, wind, and rain on beef cattle performance. Although the tests were held during the winter months, air temperatures were relatively mild with a mean of 50° F.

Rain reduced beef production more than wind but less than mud. Artificial rain of 0.19 inches during a 10-minute period each hour decreased daily gains 15 percent and reduced feed conversion efficiency 20 percent.

Wind of up to 4 miles per hour apparently had no effect on the cattle.

This publication reports research involving pesticides. It does not imply that pesticide uses discussed here have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

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